ARI Contractor Report 96-63

Final Report Validation Staff Training: Combat Service Support (CSS) Training System Development for the U. S. Army National Guard

William A. Deterline
J. Ward Keesling

BDM Federal, Inc.

This report is published to meet legal and contractual requirements and may not meet ARI's scientific or professional standards for publication.

August 1996

United States Army Research Institute for the Behavioral and Social Sciences

U.S. ARMY RESEARCH INSTITUTE FOR THE BEHAVIORAL AND SOCIAL SCIENCES

A Field Operating Agency Under the Jurisdiction
of the Deputy Chief of Staff for Personnel

EDGAR M. JOHNSON
Director

NOTICES

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY *(Leave blank)*	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	August 1996	Final Report 06/29/93 - 08/29/95

4. TITLE AND SUBTITLE
Final Report Validation Staff Training: Combat Service Support (CSS) Training System Development for the U.S. Army National Guard

5. FUNDING NUMBERS
MDA903-92-D-0075-0012
2126
CO3
623007 A794

6. AUTHOR(S)
Dr. William A. Deterline
Dr. J. Ward Keesling

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
BDM FEDERAL INC.
DOD CENTER MONTEREY BAY
400 GIGLING ROAD
SEASIDE, CA 93955

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
U.S. ARMY RESEARCH INSTITUTE FOR THE
BEHAVIORAL AND SOCIAL SCIENCES
5001 EISENHOWER AVENUE
ALEXANDRIA, VA 22333-5600

10. SPONSORING/MONITORING AGENCY REPORT NUMBER
Contractor Report 96-63

11. SUPPLEMENTARY NOTES
The COR is Michael R. McCluskey. This report is published to meet legal and contractual requirements and may not meet ARI's scientific or professional standards for publication.

12a. DISTRIBUTION/AVAILABILITY STATEMENT
APPROVED FOR PUBLIC RELEASE;
DISTRIBUTION IS UNLIMITED.

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

By 1992, information had become available that there were problems in the training readiness level of the U.S. Army National Guard (ARNG). Fundamental problems were lack of training time and guardsmen in Forward Support Battalions (FSBs) are not given adequate access to the actual equipment used in performance of their duties. This lack of realism inhibits effective training.

Two broad areas for development of training for FSB personnel were identified: 1) Training for individuals in the three operational companies of the FSB: Supply, Maintenance, and Medical. 2) Training for the FSB staff, which is responsible for coordination and synchronization of efforts to support all of the units under the control of the Brigade. Discussion in each area of instruction examines; the selection of topics to train, the steps in developing the instruction, and the formative evaluation of the lessons. A separate section is devoted to the system developed to manage the instruction. A concluding section on lessons learned addresses improvements and efficiences that could be realized in future efforts of this nature.

14. SUBJECT TERMS
Combat Service Support (CSS), Advanced Research Projects Agency (ARPA), lanes-based training, staff training, computer-based instruction (CBI), subject matter experts (SMEs), CONUS

15. NUMBER OF PAGES

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED	UNLIMITED

CONTRACT #: MDA 903-92-D-0075
DELIVERABLE #: 0012-0012AP
August 29, 1995

FINAL REPORT VALIDATION STAFF TRAINING:

COMBAT SERVICE SUPPORT (CSS) TRAINING SYSTEM DEVELOPMENT FOR THE U.S. ARMY NATIONAL GUARD

Dr. William A Deterline
and
Dr. J. Ward Keesling
PRC, Inc.

Submitted by: Mr. Michael R. McCluskey, Acting Chief
Unit-Collective Training Research Unit
and Dr. Zita M. Simutis, Director
Personnel and Training Research Division

Mr. Michael R. McCluskey, Contracting Officer's Representative

October 18, 1995
U.S. Army Research Institute

Combat Service Support (CSS) Training System Development
for the U.S. Army National Guard: Final Report

CONTENTS

LIST OF TABLES

LIST OF FIGURES

Combat Service Support (CSS) Training System Development
for the U.S. Army National Guard (ARNG)
Final Report

INTRODUCTION

Background

By 1992, information had become available indicating that there were problems in the training readiness level of the U.S. Army National Guard (ARNG). Preparations for the Gulf War (Operations Desert Shield and Desert Storm) had demonstrated that larger (battalion and above) reserve combat units would require considerable intensive training to become combat ready. Trends reported from the Army's Combat Training Centers indicated that casualty evacuation and synchronization of Combat Service Support (CSS) were persisting weaknesses[1].

One fundamental problem with ARNG training is that there are only 12 weekends and one 15-day period of active training each year -- a total of 39 training days. The geographic dispersion of the guardsmen relative to their training center further reduces the effective training time in some cases. Guardsmen in Forward Support Battalions (FSBs) are not given adequate access to the actual equipment used in performance of their duties. This lack of realism inhibits effective training.

One of the initiatives directed to address these problems was Congressionally-mandated development of improved training within the constraints faced by ARNG units through the use of computer-based technologies. The ARNG and the Advanced Research Projects Agency (ARPA) cooperated to sponsor the development of this technology, one focus of which was on improved training for ARNG FSBs.

Two broad areas for development of training for FSB personnel were identified:

1) Training for individuals in the three operational companies of the FSB: Supply, Maintenance, and Medical.

2) Training for the FSB staff, which is responsible for coordination and synchronization of efforts to support all of the units under the control of the Brigade.

ARPA and the ARNG determined that a lanes-based training approach developed by the Iowa National guard (IANG) was a suitable paradigm for the development of training for personnel in FSB operational companies: Supply, Maintenance, and Medical. Consequently, ARPA contracted with the IANG to have certain of their personnel detailed full-time to this project to provide subject matter expertise for both the lanes-based and staff training. The IANG

---

[1] Video Teleconference on *Combat Training Center Trends* conducted by the Center for Army Lessons Learned on 21 Oct 1992.

also contributed additional personnel to this effort, and supplied office space and other support. The contractor supplied knowledge of instructional development, experience in the development of computer-based instruction, and experience in the development of computerized systems to manage instruction.

The remainder of this report documents the development of instruction in each of these two areas. Discussion in each area of instruction examines: the selection of topics to train, the steps in developing the instruction, and the formative evaluation of the lessons. A separate section is devoted to the system developed to manage the instruction. A concluding section on lessons learned addresses improvements and efficiencies that could be realized in future efforts of this nature. Supplementary appendices provide background material on the nature of computer-based instruction and information about the staffing and management of the project.

DESIGN AND DEVELOPMENT OF TRAINING FOR FSB OPERATIONAL COMPANIES

Lane Lesson Front End Analysis and Design

The development of specifications for the lane training lessons was accomplished by the ARPA and IANG subject matter experts (SMEs) at the beginning of the project, during the Spring and Summer of 1993. “Lane training” originated in infantry units in the Army. Typical infantry training lanes require squads, platoons, and companies to negotiate over a designated piece of terrain in order to accomplish a specified mission. The units start in an assembly area, cross a line of departure, and navigate over a predetermined route to an objective, thus the term “lane training”. Use of the term by other, non-maneuver, types of units has resulted in some confusion over the nature of the training to which it refers.

Today the lane training strategy is used in all types of Army units. When applied in other units, the term "lane training" is somewhat of a misnomer, because in many cases the "lane" is one static location. The broader definition of lane training is: a technique for identifying, specifying, and training company and subordinate platoons in a series of related leader and individual tasks that are critical to the execution of mission essential tasks. Lanes were developed for this project using a top down analysis of missions, critical collective sub-tasks, as well as supporting leader and individual tasks. This pyramidal approach allowed the SMEs to filter critical tasks from the myriad of knowledge, skills, and abilities which seemingly carry the same level of importance.

Project SMEs had experience with training lanes developed for maintenance personnel by the IANG. These lanes take advantage of the fact that Camp Dodge has the largest CONUS maintenance training facility. Actual equipment to be maintained is brought onto the shop floor and all of the necessary tools and manuals are assembled into a lane package. Trainees then are coached through the performance of the required maintenance: they receive more coaching in the ‘crawl’ stage of training, and progressively less as they proceed through ‘walk’ and ‘run’ stages. This approach is very resource intensive and is difficult to duplicate in ARNG armories.

Computer-based instruction (CBI) was to be used, where appropriate, to provide effective instruction without the requirement of so many resources.

The first objective for the project SMEs was to perform a similar top-down analysis of the collective tasks in each company that would lead to the identification of a training lane. Then the tasks within the lane would be further evaluated to determine which of them were most suitable to training using CBI.

The project SMEs began by identifying the mission essential tasks to be performed by each of the operational companies of an FSB. From these they selected one task for each company for further development. In addition, they identified Defend Company Sector as a mission essential task that applied to all three companies. The unit Mission Training Plans (MTPs) were consulted to identify the collective tasks that make up the mission essential tasks chosen for each company. The most critical collective tasks were selected and verified by the National Training Center. To identify the topics for those lessons, the leader and individual tasks that must be accomplished to enable the unit to perform the most critical collective tasks were identified next (using the MTPs and Soldier Training Plans).

A quantitative approach was used to select tasks for CBI development. ARPA staff formulated decision criteria to derive a numerical priority value for each of the individual and leader tasks that were critical to each lane. Table 1 identifies the criteria or conditions that were used in the decision process. The criteria are a combination of performance, training, and practical conditions within which CBI could offer significant advantage. By application of these criteria, the SMEs identified tasks within each company's selected collective task that appeared appropriate for CBI development. The most important criteria in making this selection related to the difficulty of performing the training in typical armory settings. These tasks were structured into topics within each lesson.

In order to provide approximate estimates of the amount of CBI to be developed, the SMEs estimated the student completion time for each lesson. These estimates were based on the SMEs' prior experience with traditional training methods, as none of them had previous experience in making such estimates for individualized, self-paced lessons.

The SMEs also prepared descriptions of the training objectives for each task or cluster of tasks. The objectives specified the actions to be performed, the conditions under which the performance would take place in the field (including tools, equipment, and other essential materials), and the standards of acceptable performance. The SMEs obtained and assembled "lane books" that contained various doctrinal and relevant training and reference materials.

Table 1

Criteria for selecting tasks for implementation via CBI.

SPECIFIC CRITERIA:

- COMPLEXITY OF TASK (difficult of traditional training due to the skill required).
- LOW DENSITY CRITICAL TASKS (tasks that are critical to the mission but involve only a few individuals).
- EQUIPMENT SHORTAGE (lack of equipment on which to train)
- SUPPORT EQUIPMENT (lack of special tools or test equipment to conduct training).
- LACK OF TRAINERS (sufficient numbers of qualified trainers are not available).
- TIME INTENSIVE (an extensive amount of time is required to set up and conduct training).
- SAFETY (trainees can learn potentially danagerous tasks without risk).

GENERAL CRITERIA:

- REDUCED LEARNING TIME (interactive learning is up to 50% more efficient than traditional training techniques).
- REDUCED COST (compared to alternatives).
- INSTRUCTIONAL CONSISTENCY (compared to alternatives: training provided by each first line supervisor may be inconsistent in quality and accuracy).
- PRIVACY (peer pressure can adversely affect learning).
- MASTERY LEARNING (structured practice and self pacing provide a path for logical learning).
- INCREASED RETENTION (interaction between the trainee and CBI provides increased retention over time).
- INCREASED MOTIVATION (interactive learning has been shown to be highly motivational for learners).
- INCREASED ACCESS (quality training can be available to the trainee at a time and place convenient for the trainee).

Appendix A shows the original conceptualization of the lessons for each of the training lanes. During the production of the lessons some changes were made: Lesson 4 in the Supply lane was too long and was split into lessons 4 and 5; three of the Defend Company Sector lessons combined tasks for leaders and other personnel dangerous felt that these should be separated. The final lessons and their titles are listed in Table 2[2].

[2] A 'collective' lesson was planned to supplement each of the medical company and the Defend Sector lanes. Ultimately, this requirement was dropped, for reasons discussed later.

Table 2

List of Training Lane CBI courses for operational companies in an FSB.

Supply Lane	A-1 Supervise Receipt/Storage of POL A-2 Inspection of POL Products A-3 Direct POL Environment and Security Controls A-4 Tanker Operations and Safety A-5 Tank Trailer Operations
Maintenance Lane	B-1 Inspect and Troubleshoot Tracked Vehicles B-2 Repair Diesel Power Plant/Pack B-3 Test and Troubleshoot Radio Sets B-4 Repair Traversing Systems B-5 Repair/Replace TOW System on BFV B-6 Organize and Dispatch an MST B-7 Battle Damage Assessment and Repair (BDAR)
Medical Lane	C-1 Control Bleeding C-2 Survey and Triage C-3 Plan for Evacuation Support C-4 Airway Management C-5 General Casualty Management C-6 Treatment of Wounds
Defend Sector Lane	D-1 Analyzing Terrain D-2 Plan Sector Defense D-3 Prepare Support Plan D-4 Prepare for Engagement D-5 Company Prepares for Engagement D-6 Co CDR Organizes Hasty Displacement/Disengagement D-7 Hasty Displacement/Disengagement Under Fire

Lesson Development and Authoring

To be successful, the project had to blend the subject matter expertise of the ARPA and IANG staff with the course development and CBI authoring expertise of the contractor staff. Since the latter had, essentially, no prior experience with the Army, the ARPA and IANG SMEs had to supply all of the subject matter information: Doctrinally correct statements of tasks, conditions and standards, and narratives linking them into appropriate sequences. They also had to define the objectives of instruction, make the desired terminal performance clear (for both the

CBI authors and, ultimately, the students), and provide assistance with developing criterion tests to be used to assess entry level skills and monitor student progress.

The contractor developed a 17-step sequence for developing each of the lessons, shown in Table 3. This sequence assisted the managers to allocate responsibilities among the SMEs, the course developers, and the CBI authors, and facilitated tracking course development progress. The general lesson development process outlined in Table 3 was followed throughout the project with certain modifications, described below.

Table 3

Seventeen-step developmental sequence for CBI lessons.

1. SME: Does Initial Analysis and Objectives
2. SME: Prepares Content Narratives
3. Developer and SME: Develop Criterion Test
4. Developer and SME: Identify Text and AV Specs and Sources
5. QA Criterion Test and Text/AV Specs
6. SMEs working on other lessons: Review for Technical Accuracy and Completeness
7. Developer: Prepare Lesson Design
8. Developer: Completes Interactive Storyboards
9. SME: Reviews for Technical Accuracy
10. SME, Developer, CBI Author: Story board Conference
11. CBI Author: Converts Storyboards to CBI
12. SMEs: Alpha Test Lessons, QA CBI Draft, Specify Revisions
13. CBI Author: Revise CBI Test Version
14. Developer/SME: Beta Test: Conduct Individual Trials, 2/3 Soldiers
15. SME and CBI Author: Specify Revisions
16. CBI Author: Revise, Retest
17. Deliver Final Version to PRC, Monterey

Some SMEs were not able, for a variety of reasons, to provide a written content narrative. They preferred to provide informal tutorials, with the SME providing the information while the contractor staff member took notes. This method was less efficient than a documented approach (see the "Lessons Learned" section of this report), but was accepted by the contractor at the SMEs' request.

Step 3, the development of the criterion test for each lesson, was generally, at the request of the SMEs, deferred until later in the sequence, usually after the CBI authoring had been completed in step 11. This deviation from procedure is also discussed further in the Lessons Learned section of this report.

After completion of their front end analysis the SMEs served as consultants to the course designers and developers, answering questions and providing additional details as the developers worked with the information already received. At Step 8 the standard procedure for designing interactive, self paced instruction, would consist of course developers preparing storyboards, specifying the guided practice and providing the explanation and demonstration specifications for use by the CBI authors.

The next sections provide a brief overview of the lessons: their overall structure, the use of multimedia content, and the way in which student progress is recorded and monitored. Appendix B contains some background material on the nature of multimedia computer based instruction.

Structure of the CBI Lessons

Each lesson consists of the instruction itself; plus a pretest and a post test. The two tests are composed of identical items, but serve two very different purposes. The pretest determines how much the trainee already knows about the lesson topics, and whether he or she is already proficient enough to be allowed to skip or bypass any of the topics of the lesson, or even the entire lesson. The post test, on the other hand, determines the trainee's proficiencies on the lesson topics upon exiting a lesson.

Each lesson consists of "topics," which are subsets of the objectives that comprise the performance requirements covered by the lesson. A trainee may, if desired, go through the lesson in any desired sequence of topics, although trainees new to the subject matter are advised to proceed in the sequence specified by the course map.

The intent of CBI is to provide guided practice, keeping the trainee actively involved with the subject matter: interpreting information, processing it, and applying it to answer questions and perform tasks presented in the lessons. In these lessons guided practice takes the form of questions and tasks presented to the trainee approximately every two to four minutes. The trainee receives immediate feedback after each response; that is, the trainee is told whether a given answer was correct or incorrect. The corrective function of feedback after an error is to keep the trainee from forming a misinterpretation or faulty conclusion and carrying it forward, thinking that it is correct.

Multimedia Components of the CBI Lessons

The computers used by the trainees are essentially standard, relatively high performance (80486-based) systems with multimedia kits (CD ROM drive, sound card, speakers). Additional capabilities consist of a local area network (LAN) card, a fax/modem card, and a special video card. The sound and video cards allow IconAuthor to present audio files and video files as part of the lessons; the fax/modem card and the LAN card allow the CBI computers to communicate with each other, locally or at a distance over phone lines.

The CBI authors used the IconAuthor course writing software to design lessons that present screens containing text, still or animated graphics, video stills or animated clips, and audio clips, either alone or in combination with each other. Audio files accompanying other media were either started automatically, or were controlled by the trainee through the use of an 'audio button' that allowed the trainee to activate the audio when he/she was ready for it, and allowed the audio to be repeated as often as the trainee desired. Each lesson made use of all of these components, as required.

A variety of question and answer forms appear in the lessons, mostly multiple choice, true false, matching, and sequencing, with occasional requirements for the trainee to type in short entries. Some of the questions were about verbal descriptions of events, conditions, or scenarios; as often as was possible and practical, the questions were about graphic representations of those events, conditions, or scenarios.

Because it was clear that many of the soldiers making up the target audience for the lane lessons might have had no previous experience with computers, or with Windows' features such as the graphical interface, the mouse, dialogue boxes, buttons, and so on, an introduction was prepared, presented by the computer, to explain and demonstrate to the trainee just how the lessons and the navigational elements were to be used. This introductory "lesson" was informally beta tested and delivered as an element included at the beginning or each lane CD ROM to be delivered to the field.

Test Performance Criteria and Course Progress

The trainee's raw score on the quiz at the end of a topic is compared to a pass/fail criterion established by the SME and instructional designer and verified by the external SMEs who reviewed the lessons. Generally those internal topic criteria range between 80 and 100 percent. The trainee is told only that he or she has passed or failed the quiz.

When the trainee completes the topic quiz, the lesson returns to the lesson selection menu screen. If the topic has been completed with a test score above the established criterion score, a "thumbs up" graphic appears beside the button for that topic, indicating that the trainee has received a "go," or passing score. If the score was below the required level, the thumb points down. The trainee is advised, whenever a "thumbs down" appears, that he or she should retake that topic before taking the post test. Full credit is recorded for a trainee for a lesson only if the post test indicates that all topics have been passed successfully.

It should be noted that although the trainee receives immediate feedback after all active responses during the lesson itself, no feedback is provided after each of the test items on either the pretest or the post test. Providing feedback on the test questions might tempt trainees to record the answers to the questions and then use them to earn undeserved credit.

Formative Evaluation of Lessons

A formative evaluation plan was prepared, providing methods and procedures for quality review of the CBI lessons at several stages (Deterline, 1994). The QA conducted at steps 5 and 6 of the developmental sequence (Table 3) involved CBI developers and SMEs working on other lessons. The basic purpose of this review was to get an independent review of the initial design and development specifications for the lesson.

The alpha tests (step 12 of Table 3) were quality control reviews of completed CBI by project SMEs other than those assigned to that lane, as well as other SMEs from Camp Dodge units. For example, the commanders and selected staff of the Regional Training Site -- Maintenance, and the Equipment Maintenance Center -- CONUS, located at Camp Dodge, reviewed several of the maintenance lessons for technical accuracy and to provide comments on the instructional design of the lessons. Similarly, members of a medical company based at Camp Dodge reviewed the medical lessons. Other appropriate SMEs reviewed the other lane lessons. Generally, the number of problems navigating through the course exceeded the number of doctrinal errors. All errors or flaws found during alpha testing were corrected (step 13) before a lesson went on to be beta tested.

The beta testing (step 14) was a direct test of the effectiveness of each lesson on target audience trainees. Soldiers holding the MOSs for which the lane lessons were designed (when such trainees were available and accessible), took each lesson in exactly the manner in which the lessons will be taken in the field. Each lesson was beta tested by a minimum of two test trainees, with revisions being made after each test, as necessary (steps 15 and 16). As a rule, if revisions were required after the second test trainee, an additional trainee beta tested the lesson. Keesling (1995) documents the beta test results on the lane training CBI lessons, showing that they are very effective at training the target students.

STAFF LESSONS

Concurrent with the project to develop computer-based training for FSB personnel, ARPA initiated a project conducted at Ft. Benning, GA to develop training for the battle staff of a maneuver battalion. Lessons developed in that project were the basis for the development of lessons for the staff of the FSB, and its counterpart in the separate brigade -- the Support Battalion (SB). This section of the report describes the staff positions for which instruction was to be developed, outlines the Battle Staff Training System (BSTS) work at Ft. Benning, and describes how the FSB and SB staff lessons were developed in coordination with that project.

FSB and SB Staff Positions Compared to Maneuver Battalion Staff Positions

The staff structures of the FSB and SB differ from each other and from that of the maneuver battalion. These discrepancies had to be accounted for in developing the instruction for the different staffs. Some of the staff officers perform essentially the same functions:

• The Executive Officer (XO) in all battalions is devoted to staff supervision.

• The S1 is devoted to personnel.

• The S4 manages internal logistics.

The major differences are associated with the S2 and S3 positions. In addition, the FSB and SB have additional staff officers not present in maneuver battalions. These differences are highlighted in Table 4.

The FSB staff structure combines the S2 and S3 positions and devotes this position to internal management. The S2 of the SB also is internally focused. In both cases these officers do not have the reconnaissance asset (scout platoon) that the maneuver battalion S2 must manage. The S2/3 of the FSB and the S2 of the SB are concerned with security of the area(s) from which support services are provided, they coordinate with other staffs to obtain the intelligence they need to develop security plans.

The FSB structure adds the Support Operations Officer (SPO) to manage the external relationship to the supported unit(s). The SB structure gives those duties to the S3. In a maneuver battalion the S3 is directs combat operations in accord with the Commander's intent. The SB structure adds a Brigade Material Management Officer (BMMO) to provide additional management of supply and maintenance functions.

These differences, which are only sketched here, meant that the instruction for the FSB staff officers had to be modified considerably from the materials originally developed for maneuver battalion staff officers. Instruction for the SPO and BMMO was developed entirely by the Camp Dodge team of SMEs, instructional developers, and CBI authors.

Appendix C gives the original course content specification for the FSB and SB staff positions, as developed by the Camp Dodge SMEs. This appendix also indicates the estimated instructional time for these lessons. The BMMO course was designed to be used in either of two ways, depending on the prior experience of the each trainee: trainees with previous experience as an SPO in an FSB need take only the lessons in the BMMO course. If, however, the trainee lacks that prior experience, both the SPO course and the BMMO course will be assigned.

Table 4

Comparison of selected staff positions: FSB, SB and maneuver battalion

Maneuver Battalion		Forward Support Battalion		Support Battalion	
Staff Position	Responsibilities	Staff Position	Responsibilities	Staff Position	Responsibilities
S2	Internal: Intelligence (Enemy, Terrain, Security, Weather); Combat Area	S2/S3	Internal Operations: Operations, Intelligence, Security, Training	S2	Internal: Intelligence (Enemy, Terrain, Security, Weather); Support Area
S3	Internal: Combat Operations; Training			S3	External: Manages Supply, Maintenance and Medical Companies through three assistant S3s.
		SPO: Support Operations Officer	External: Manages Supply, Maintenance and Medical Companies; coordinates transport and field services.	BMMO: Brigade Material Manage-ment Officer	Manages Supply and Maintenance; Controls Property Book

The Battalion Staff Training System (BSTS) Project at Ft. Benning.

In addition, to the staff members discussed above, the BSTS project also developed lessons for the Fire Support Officer, Air Defense Officer, S3-Air, Engineer Officer, Signal Officer and Chemical Officer.

The staff lessons developed at Ft. Benning were, generally, of a different character than the interactive CBI lessons developed for the lanes training of the operational companies of the FSB, discussed previously. These lessons made use of a technique referred to as Computer Managed Instruction (CMI) that serves to tie off-line study to computer-based testing and record keeping. Typically, each lesson begins with a brief introduction at the computer, followed by the lesson pretest. The on-screen directions then tell the trainee to leave the computer to read a text

lesson[3], then return to the computer. Upon the trainee's return, the computer then provides a practical exercise, followed by the post test for the lesson. The trainee receives go/no-go information on the lesson topics, with advice to restudy the no-go topics. Then the CMI track moves to the next lesson and a similar set of components.

CMI allows integrated use of any variety of off-line instructional materials, media, or instructional events. These instructional events might include activities such as: taking CBI lessons that are not otherwise integrated into the training management system; reading text materials; looking up information in reference documents; watching a videotape; participating in a simulator exercise; observing a demonstration of equipment; participating in or observing a field exercise and critique; and any other kind of instructional or informational event deemed relevant to the course objectives.

Coordination of the Ft. Benning and Camp Dodge Projects

Completed products from Ft. Benning were to feed into the development of the FSB staff lessons at Camp Dodge. The plan was for the SME and contractor staff in Iowa to receive the Ft. Benning lessons as those lesson were completed, and modify them for the FSB and SB staffs. The plan specified that this would involve removing lessons or segments of lessons that were not relevant to the performance of the CSS FSB and SB staffs, and adding CSS specific topics.

This plan assumed that all lessons would be CBI lessons. When a lesson developed at Ft. Benning and sent to Camp Dodge was in CBI form, the modification for the CSS staffs was relatively straightforward. These revisions involved removing battle staff content that was not relevant to the FSB staffs (in some cases, deleting entire lessons for this same reason), and adding segments to cover tasks unique to the FSB or SB, not covered in the Ft. Benning materials.

The text lessons presented a more difficult problem. One possibility would have been to convert the text lessons into CBI, making the appropriate changes during this revision. This would have been tantamount to developing all new CBI instruction, taking very little advantage of the development at Ft. Benning. The contract did not have a provision for such a large undertaking. The alternative chosen was to modify the text lessons and the accompanying CMI. In this way the staff lessons for the maneuver battalion and the FSB/SB have the same 'look and feel.' Using additional funding provided by ARPA, the projects at Ft. Benning and Camp Dodge hired additional personnel to accomplish the conversion of the text lessons.

---

[3] A text or print lesson is hardcopy developed by the Ft. Benning staff, gathering and rewriting information from training manuals, field manuals, and other relevant source documents.

The Camp Dodge staff revised and modified the CMI segments and practical exercises for all of the FSB and SB text lessons. All of the CMI segments had to be revised because the introductory audio narrative and print screens addressed battle staff topics that was inappropriate for the FSB/SB staffs. This meant modifications had to made to the introductions, exercises, and to the pretests and post tests.

Camp Dodge staff performed the tasks involved in combining relevant portions of the S2 and S3 SB lessons developed at Ft. Benning to create the S2/3 text lessons, CBI lessons and CMI. In early June of 1995, with the work appropriately 50% complete on the S2/3 lessons, word was received from ARPA that the S2/3 materials need not be completed.

Appendix E describes the formative evaluation of the FSB/SB lessons.

THE TRAINING MANAGEMENT SYSTEM: EMMii

It is not enough to provide training for soldiers. Even very effective training that helps soldiers develop mastery of relevant tasks that are essential to performance of unit missions must be managed so that it can be made available to trainees on a timely basis, and must yield information that commanders at all levels can use to determine the readiness levels of individual soldiers and units.

Purpose

In both public education and military and industrial training, it has long been known that "completion of a course," or "exposure to n hours of instruction" are less reliable indicators of individual competencies than direct assessments of performance. The military emphasis on training to attain a specified level of proficiency on mission essential tasks reflects the understanding that participation in a number of exercises does not guarantee unit readiness. Unit commanders at all levels must have access to information about individual and unit proficiency so that they may allocate training resources to allow their units to attain and sustain their assigned readiness status.

The requirements of any training management system are that individual and unit performance on relevant tasks must be observed, measured and evaluated, identifying shortcomings as well as competencies. The measurements and evaluations must be recorded and made readily accessible to commanders and training managers so that they may determine which units and soldiers need what additional training. The management system should also contain information on what training is available, and tools the commander and training managers can use to manage unit training to eliminate any critical deficiencies in the performance of individuals and units.

The Environment for Multi-Media Interactive Instruction

The Environment for Multi Media Interactive Instruction (EMMii) was developed by BDM from its proprietary Training Management System, a system that was originally developed in an industrial setting to provide the functions outlined above. EMMii is a shell that surrounds the instruction, providing controlled access and egress so that the information needed by training managers may be gathered automatically as the soldiers progress through the lessons. The functions and applications that this system permits are outlined below. Additional information may be obtained from the User Manual (BDM, 1995).

The EMMii introduces the trainee to a set of lessons, matches the records to the soldier's name, Social Security number, unit and other *pro forma* information, then records pretest and post test scores and the designations of the lessons completed successfully or completed only in part. The data gathered from trainee lesson performance is stored in data bases that can be accessed by individuals identified for EMMii by a System Administrator (SA). The SA, the highest level of EMMii manager, can specify various level of access, so that any desired level of confidentiality and security can be established and maintained. The trainees, for example, have 'read only' access to lessons and to their own records: they may not edit any entries pertaining to their schedules or performance data.

The Trainer's and Student Guides to the lessons and EMMii (xxx references xxx) contain directions for properly accessing EMMii; the Student Guide also contains a job aid to guide a trainee through EMMii and the selection of lessons, and directions on how to transfer the performance data back to the training manager. Along with these two Guides, units will also receive a copy of the EMMii User Manual for use by the SA and by training managers.

Applications

EMMii can deliver lessons in three basic ways (with variations):

- via a local area network (LAN) of two or more computers, with a manager station that maintains the master and subordinate databases and controls a file server
- via student stations in standalone configurations tied to a manager station via modem
- via CD to standalone student stations that are not connected to any other computers.

In the latter application, the standalone student station could be located in an armory, some other location designated for ARNG training, or at a location most facilitative to the trainee, such as the trainee's residence.

Typically, the LAN setup would have all computers in a single location (e.g. an armory). In this setting the student would not use lessons on CDS. The training manager would determine

a trainee's schedule in consultation with the trainee's commander and the trainee to be sure that times and dates are viable. Then the training manager would schedule individual lessons for a trainee, assigning a specific student station by date and time. EMMii would determine the appropriate time to begin downloading the scheduled lesson from the file server into the identified student station for the trainee. Because multimedia CBI lessons tend to be large in size (tens of megabytes) the downloading time is significant and downloading must be scheduled for blocks of time when the file server and student station can be unavailable for other uses. When the trainee arrives at the scheduled time, the lesson is ready, the student accesses the lesson and completes it. Student times for beginning the lesson, completing it, and test scores are gathered by EMMii and stored in the appropriate database in the manager station. Depending on what is scheduled next for that student station, EMMii will then unload the completed lesson.

In an armory without an established LAN, a trainee will pick up a lesson CD and a 3.5" floppy disk from the training manager or a designate performing that function. Following the directions in the Student Guide, the trainee will turn on the computer, which will boot to the EMMii's trainee selection screen. The trainee enters a user ID and password; selects a lesson, then inserts the floppy disk and proceeds through the lesson and its tests. After the trainee completes the lesson, the EMMii will load the lesson data onto the floppy disk. The disk is then returned to the training manager or representative, who will copy the data from the floppy disk into the appropriate database.

In some settings trainees will be allowed to take a student station home to take the lessons there. The course CDS will usually be provided to the trainee at the time the computer is signed out. The floppy disk that will serve as the interface between the training manager's station and the remote location will also be delivered to the trainee at that time. The trainee will use the CD and the floppy disk exactly as they would be used in the non-LAN armory. To expedite transmission of the trainee's data to the EMMii, instead of hand delivering the floppy disk and its data to the training manager, the trainee, upon completing the lesson, will connect the computer's modem to the home telephone line, and the data will be sent from the student station to the manager station via modem.

Commanders or their representative can access the lesson databases from various points of view. One might check on individual soldiers to determine which lessons they completed and when. Or one might want to determine how many commissioned officers or senior noncommissioned officers have successfully completed, say, the Defend Sector or the staff S2 course, or which lessons from those courses. Such searches can also be by sub-units: a battalion can check on each of its companies and the platoons within each company separately. In this way, "holes" in the training of the units or of individuals assigned to the units can be determined, and proper action can be taken on a timely basis.

EMMii also keeps track of the responses made to each of the quiz and test items on each lesson. Over time, masses of performance data will be accumulated for large numbers of

soldiers. EMMii also accumulates opinion statements from trainees. For this purpose the trainee is offered a choice from among statements such as:

1. The vocabulary used in this lesson is about right for me.
2. The vocabulary used in this lesson was too simple.
3. The vocabulary used in this lesson was too complicated.

EMMii accumulates counts of such selections, and these, like the item response counts, can be accessed by CBI authors and instructional developers for the purpose of identifying areas needing revision or improvement.

EMMii is not a simple system to learn or use. In order to utilize it to its full extent, individuals with computer experience will have to spend considerable time mastering the system. The need for training in the use of this system led the ARNG and ARPA to substitute development of such training for the collective training lanes mentioned earlier (Table 2).

LESSONS LEARNED

This section of the final report presents observations about the project that could prove useful to others attempting similar developmental efforts. These observations are organized into three themes:

Staff Resources
Hardware
CBI Production Methodology
Project Expectations and Oversight

In some cases the lesson learned involves more than one of the theme areas. Rather than repeat the lessons, they are placed where they seem most relevant.

Staff Resources

ARPA/IANG staffing. ARPA and the IANG were very generous in providing SMEs to support the project. These SMEs were very proficient in their areas of expertise, and they had prior experience with managing and delivering Army training. They were less experienced with such Army training models as instructional system design (ISD) and had virtually no prior experience with developing CBI. A few had experience with the IANG lanes training methodology which parallels the ISD model. The lack of training in ISD meant that they did not find it easy to develop terminal learning objectives and work backwards to identify all the enabling objectives that would require training. The inexperience with developing CBI left them unsure as to how to chose among media and methods for presenting a particular topic, and what capabilities they could expect of the hardware and software. To some extent, the expertise of the contractor staff could make up for the SMEs inexperience with multimedia instructional

development, but the contractors could not substitute for the SME expertise in identifying learning objectives and measures of proficiency.

Contractor staffing. The initial staffing by the contractor consisted of a manager and administrative assistant, and four people who were to design and author the courses. Each was paired with an SME to work on one of the training lanes. These personnel had academic backgrounds in instructional design and CBI, and most of them had worked on prior CBI development projects. None of them had prior experience with the software system chosen for this project (IconAuthor). The contractor staff was given only minimum training in December, 1993, on the authoring system. Two people attended a one-week workshop, while three other staff members were given two days of training.

The inexperience with IconAuthor meant that while they were trying to understand the subject matter sufficiently to design a logical course flow, including all the guided practice, the instructional designer/authors were also trying to learn enough about the features of the software to be comfortable with making choices about the way in which to present the material. Some of the capabilities of IconAuthor required a facility with the C programming language, and only one of the contractor staff had such experience.

Later in the project it became clear that additional personnel would have to be hired to meet the deadlines and that greater role differentiation would also be beneficial. Additional personnel were hired and contractor personnel were assigned either to design courses (i.e. develop storyboards and identify supporting materials), or to create the courses using IconAuthor[4]. Had it been possible to hire some IconAuthor experts at the outset (none of the applicants had this expertise) this role differentiation could have been established earlier which would have facilitated the production of the courses.

Another example of the need for role differentiation was the early lack of personnel devoted to the creation of graphic materials. Project managers anticipated being able to find graphical material they needed in public domain or commercial clip art collections, Army documents, or archives (photos and video). This proved to be incorrect, and for the first few months of the project, the designer/authors were also drawing the graphical materials they needed. They and the SMEs also found it necessary to re-shoot video sequences because the versions in the Army archives were not of sufficient quality to import into the lessons. Later in the project, full motion video was used less frequently and graphic artists were hired to create drawings and animations.

Recommendations. Projects such as this should try as much as possible to maintain the role distinctions between SMEs, instructional designers/developers, and CBI authors. Each of

[4] It is worth noting that the BSTS project developed storyboards in one location while IconAuthor experts, in another location, converted them into courses.

these three groups will benefit from knowing exactly what each of the other groups requires as inputs, what each group does and produces as outputs, and how the work of each group can most advantageously and beneficially serve the other two groups. Training can be provided to increase this understanding at the outset.

In the case of the present project, the SMEs and some contractor personnel would have benefited from training in the ISD methodologies. The ISD training can be lighter for the CBI authors, but should be thorough for SMEs and the instructional developers. The contractor staff (designers and authors) would have benefited from training in military culture (e.g. terminology, equipment, operating procedures), focusing on the units for which they were developing instruction. Additional training in the instructional authoring software (in this case, IconAuthor) would also have been beneficial. Introductory training (stressing capability and functionality) would have sufficed for the SMEs and developers, while more thorough training (stressing application and development) would be required for CBI authors. The ISD training could have been provided by contractor personnel (perhaps drawing on other corporate resources), while the SMEs could have provided the military background training.

Hardware

Desktop and portable computers were purchased to perform three different functions: Authoring courses; delivering instruction to students; and providing general support to the project. The latter machines were called 'administrative' computers. Eight such machines were purchased so that the SMEs and contractor staff would have the capability of preparing text and drawings, as needed. Some of these computers were also used for project planning and administration. These systems were made available in the early fall of 1993, after the staff had been assembled.

In November 1993, two multimedia authoring computers were provided to the project. Each was a 486, 66 MHZ computer with eight megabytes of memory, a 540 megabyte hard drive, 1.4 megabyte floppy drive, CD ROM drive, with a fax/modem card and audio and video cards, and a Super VGA color 14" monitor, 101 key keyboard, and a mouse. Each authoring station also had an installed tape backup unit and an uninterruptable power supply and surge protector. Purchased as 'high-end' machines, by present (1995) standards these computers are barely 'entry level' for serious applications.

Problems in determining how to configure the authoring system computers, the software, and the add-in cards to prevent conflicts that caused the systems to crash introduced delays in the project during November and December of 1993. One of these machines proved to be persistently unreliable, despite several service visits and one return trip to the manufacturer. The late and constrained availability of these machines delayed the training in IconAuthor, and created a bottleneck in development as the four authors were often contending for the machines.

Several hardware problems were related to the desire to provide high-quality video clips. Capture and playback of high quality video clips required a special-purpose video card. There were persistent problems in configuring the administrative machines (being used for draft development) and the authoring stations to use the same color palettes. Thus, color choices (e.g. for graphics) would not remain consistent when ported between the administrative machines and the authoring stations. Sometimes this was merely annoying (or amusing), other times it meant that information on the screen could not be seen. This problem was resolved by standardizing on the authoring stations as the 'target' platform. To the extent possible, the administrative and student stations were configured to work properly with this standard.

The special video boards created another problem. When additional authoring machines were rented to support the staff added later in the project, these video cards were no longer available. This meant that the bottleneck could only be partially relieved by acquiring the added equipment.

Home quality VCRs proved to be inadequate for copying video from tapes provided by the government, so the contractor rented a professional quality video camera with a high quality playback unit. The camera was also used to record video footage when that could be taken at Camp Dodge or nearby armories. The rental cost eventually added up to more than it would have cost to purchase this equipment.

Video is costly in other ways. Video clips take up a lot of disk space (several megabytes for one minute of video is not atypical), increasing the storage requirements for the course. The size of these files also means that students are required to wait some time for the file to load before it can be played. These delays are sometimes quite distracting.

Video on computer is still an emerging technology. It tends to be jerky and to lose resolution. Some of the medical lessons benefited from the use of video to show exactly how to carry out certain procedures with high realism. These videos had been prepared expressly for the purpose of illustrating these procedures; extant video is not often aimed at the desired instructional objectives. Otherwise, this technology was not generally required. The videos that were used as introductions or attention getters (trainees who beta-tested the lessons did express appreciation for these video clips) did not have to be of very high quality. It might have been preferable to use a lower quality video capture and playback system (one that would continue to be supported by hardware and software manufacturers), even if the video was of lower quality.

After the first authoring stations arrived a "luggable" (larger and heavier than a typical laptop) computer was provided. At the time this was considered likely to be the kind of computer that would be purchased as a 'student station.' The luggable had a VGA active matrix color screen, and sound and video cards. The limitations of the luggable soon made it clear that desk top computers would have to be used instead. However, the luggable proved useful and convenient for taking lessons to the IANG Armory where it could be connected to a large screen for demonstrations for visitors, and for use by the SMEs at military conferences.

A black and white scanner was purchased for one of the administrative computers so artwork and other graphics could be scanned into the computer. The scanner had no Optical Character Reader (OCR) software. The latter would have been helpful when forms, labels, and other existing text had be scanned in, because without the OCR, such material had to be scanned in, in graphic form, rather than text form, which was difficult to modify.

The black and white limitation was not severe since most of the reference material illustrations (primarily in TMs) were not in color. A few printed color illustrations were identified that would have been appropriate, but could not be used. Still color visuals were captured from videos wherever possible (rapid motion of the camera or the subject blurs the images). This proved to be a very good source of color still images.

Recommendations. Each author should be provided with a fully-capable authoring station. The cost to do this is not prohibitive. The configuration should not rely on exotic devices (such as the video cards used in this project). Standards for motion video on microcomputers are changing rapidly. It is expensive to shoot new video, but extant video is often not designed specifically for the instructional purpose at hand. Future projects will need to weigh carefully the trade-offs between enhanced quality, costs of capture and storage, and the potential for continued support of the video technology.

Extant video libraries can be a valuable source of still images. Capturing these images should be a capability of projects like this. A color scanner, with OCR capability, would also be a valuable addition to such projects, although a black and white scanner may be sufficient.

Removable hard drives are likely to be a better solution than tape for back-up and transfer of course files. In some cases they may be preferable to CD ROMs, if the course is sufficiently small.

Finally, provide each computer with the best surge protection possible. Storms in the Camp Dodge area severely damaged several machines. Uninterruptable power supplies are a must for the authoring stations where complex work needs to be saved and the machine powered down gracefully when the main power is disrupted.

CBI Production Methodology

In this section several techniques for enhancing CBI production are discussed. An attempt has been made to highlight methods that may be isolated from the hardware, software, and staff training lessons learned, to enhance their range of application. Topics to be discussed are: setting realistic time frames for development, following the developmental sequence, using standard templates, using animation in place of video, keeping lessons to appropriate length, and embedding audio in the lessons.

The first three of these lessons learned have to do with overall project management and efficiencies of production. They are somewhat interdependent because following the developmental sequence and using standard templates are ways to assure that development can be accomplished in a realistic time frame.

Setting realistic time frames for development. Authoring CBI is a very time consuming task. Each lesson requires the CBI author to establish the overall structure of the lesson, compose screen copy, create smart object pages and variable pages, select colors, window sizes and placements, do the selection and placement of active buttons, create audio files and video files, and provide for the activation of audio files and video files, graphic files and embedded graphics. Industry estimates of time required to produce a one hour highly interactive CBI lesson range from 300 hours to 500 hours, more when multimedia CBI is the format. Tables developed by Golas (1993) indicate that 1000 hours, or ½ of a person-year, would be required (including time for development of storyboards)[5].

The original production schedule of 15 months was optimistic. Floods in Iowa in the summer of 1993 delayed hiring staff to some extent and required some of the IANG personnel to be involved in disaster relief operations. The project authoring stations did not arrive for several months after the project start, delaying training of the authors. Further delays resulted from having to debug the systems. These problems had to be acknowledged in later adjustments to delivery schedules.

Recommendations. The inadequate early staffing and the small number of authoring stations, discussed earlier, are problems contractors should avoid. On the government side, it is important to base schedules of deliverables on a start date incorporating the availability of hardware and software. The follow-on to this project was funded under a contract that states deliverable due dates in terms of months after the time when all hardware and software are on hand and fully operational.

Following the developmental sequence. In earlier sections two specific discrepancies from the 17-step sequence developmental sequence (Table 3) were mentioned. These deviations had a negative impact on the production of deliverables.

1) The SMEs were to provide a written narrative discussion and explanation of the each of the tasks listed in each lesson's objectives, the performance setting, the equipment, and anything else relevant to the lesson that the developers would need to know. In some cases such information was prepared in writing, but the SMEs generally preferred to provide necessary information of that sort in conversations, in answering questions, or after identifying holes or

---

[5] This estimate assumes that CBI is to be used to make a medium-level presentation (moderate use of multimedia components), intended to teach a skill. Developer unfamiliarity with target audience was incorporated as a factor in the estimate.

deficiencies in draft storyboards. This approach did the job, but was not as efficient as the written documentation. Furthermore, except for any notes taken by the developer, it did not produce adequate documentation for the quality assurance reviewer to look at later.

2) The 17 step developmental sequence also specifies that a criterion test should be developed by the SMEs, or by the SMEs and developers working together, as the final step in the analysis process. Course development should not begin until the tests are complete. Many of the subsequent design decisions are thereby made more easily and more accurately. The SMEs were not familiar enough with the ISD process to recognize the critical importance of this step, and preferred to develop the tests later. Unfortunately, this resulted in gaps in training and testing the necessary performance as defined by the objectives, requiring modifications of both the tests and the lessons.

Another example of disruption to the developmental sequence occurred when the contractor was asked to accelerate development in a particular lane in order to have material ready for a demonstration. Despite the fact that the contractor pulled staff from other lanes to add to the target lane, it was not possible to meet this additional requirement. Part of this was due to the fact that there was only one SME. That single SME could only maintain the same pace of instructing developers on the lesson content. Having more developers did not speed up the process because there was no way for them to work in parallel. Additional authors would have been helpful if there had been more of a backlog of developed material to work with. Of course development of the other lanes was disrupted, and some shortcuts in the development of the target lane were made that had to be patched up later.

<u>Recommendations</u>. Training in the ISD process would reinforce the need to follow the logical sequence of developmental steps. The sponsors have to agree to the schedule and be willing to show the intermediate products (storyboards, for example) as representative of progress, until such time as lessons become available through the developmental process.

<u>Using standard templates</u>. The purpose of developing or assembling a standard set of templates, or artwork, is not to limit the authors, but to facilitate lesson authoring. Templates or assembled artwork can be modified as desired or to meet special requirements. For example, the template described in Appendix B for navigation buttons was developed early in the project and used throughout. This spared the authors from having to re-invent the navigational scheme for each lesson. Similar advantages can be obtained from sets of templates for page layout, design, colors, and other on-screen button functions.

Early in the project, CBI authors reviewed guidelines and experimented with various screen colors and color combinations, for backgrounds, boxes, buttons, and foreground text. Standards for color use were developed to provide guidelines for use in all lessons. In general, medium blue or dark blue were found to be the most desirable as background colors, with highlighted white text. A second choice was a light blue background with black text. Green and red were less attractive (except a very light green) and were rarely used, except where an outdoor

scene made green appropriate. In general, any hue of dark lettering on a dark background proved to be undesirable because of legibility problems; similarly, white lettering on a light background was difficult to read because the contrast between foreground and background was inadequate.

Because red is a dramatic color, it was used to highlight critical components of graphic illustrations or even critical words in on-screen text. This use included red arrows, circles, red rectangles with labels and names of components, either fixed in place on a graphic, or appearing briefly and then vanishing. This technique must be used judiciously to avoid wearing out its welcome.

Recommendations. It is strongly recommended that future CBI projects make maximum use of standard templates, developing many at the start of the project, and adding others, as needed, to meet special requirements. All standard templates and artwork should be assembled into a convenient hardcopy catalog, like those that accompany sets of clip art, showing a copy of the dimensions and layout of each template and a copy of each piece of artwork.

The next two lessons learned concern specific aspects of multimedia CBI. Animation can be substituted for video in many cases, with several benefits. An additional way to present audio was developed in this project that may be useful to other projects.

Using animation in place of video. Animation was used only to a limited degree during the early months of the project. During the Spring of 1994, the CBI authors and the recently hired graphic artists began to explore the use of animation as an effective and efficient substitute for motion video, which was difficult or impossible to obtain or produce.

Animation proved especially useful, in one of the maintenance lessons, in showing how a subsystem was disconnected and removed from inside a Bradley Fighting Vehicle (BFV). The trainee's task was to choose the next component that should be removed, in its turn. A line drawing illustration from a TM served as the basic piece of artwork. It was scanned into the computer, then retouched and colored by a project artist. When the trainee indicated the correct component the animation showed it being unbolted and leaving the scene. For realism, the sound of an air impact wrench was introduced as the retaining bolts were shown removing themselves to release the component. No mechanic appeared on screen during the removal process. That would have required animation of a human figure which would have been expensive and would not have added to the instructional value. The animation was shown from the point of view of the mechanic as he or she would view the piece of equipment.

One basic illustration was used for the entire sequence, with drawings of each component proportional in size to the scene. As each component was detached it was removed from the scene. That component then was missing from the main illustration, having been touched up and out of the picture. This was a very economical use of animation; attempting to obtain the same scene on video would have been difficult because of the small space involved, and the difficulties involved in lighting and photographing the scene to control reflectance, shadows, and contrast.

Animation has an additional advantage that might in some cases become critical: file size. Even relatively short video sequences tend to require from five to twenty times the space taken up by an animation sequence, depending on the nature of the animation and of the video used. The storage requirement may not be as important as the time required to download a video file from the CD ROM disk onto the computer's hard drive. The nature of the hardware and the size of video files causes significant presentation delays -- in some cases more than two minutes while video files are being loaded.

Recommendation. As a substitute for or complement to video, simple animation can be very cost effective, and is highly recommended.

Embedding audio in the lessons. The authoring program used allowed the creation of embedded audio that was activated automatically when a screen image changed. This use is adequate for introductory statements or information about the a lesson. It has one possible and potentially serious disadvantage: while text appearing on screen can be read and re-read by the student, embedded audio that is triggered by a screen change "goes by" only once and must be attended to and "caught" as it passes. Sometimes it would of advantage to the trainee to be able to listen to an audio message a second or even a third time.

A different way of presenting audio was developed by 'detaching' the audio from the screen advance function. An audio button appears on the screen, labeled as "audio" with the speaker icon representing sound. The trainee is told, in the text on screen, to press the audio button to hear the audio segment. This allows the trainee to listen to the audio when ready, and, more importantly, to repeat the audio as often as desired. Several trainees commented favorably on this particular aspect of the use of audio.

Recommendation. Allow the students to access audio when they are ready, and allow them to repeat the audio segment as often as they feel is necessary.

The final lesson learned involves a finding from the beta testing concerning the optimal length of the CBI lessons.

Keeping lessons to appropriate length. The beta testing of the training lanes revealed that certain lanes were much longer than 90 minutes and were associated with lower post test scores. One explanation for this phenomenon is that because the lessons are designed to actively engage the trainee, when the lesson is longer than one hour the trainee will become fatigued, making it harder to learn new material, and will also begin to forget details learned earlier.

Recommendation. There may be some variation among individuals in tolerance for longer lessons, but generally speaking, it seems to be a good policy to keep lessons very close to one hour in length. This would also make the lessons easier to schedule around trainees' work schedules, since one hour assignments away from work are generally easier to schedule than assignments that run to two hours or longer.

Project Oversight

Project oversight was one of the most difficult aspects of this project. There were several stakeholders, and many ways of passing information about project expectations. It was difficult, at times, to reconcile the apparently different points of view about project goals. This section should be read as a set of recommendations for improving project performance, not as a set of complaints or rationalizations, or as attempts to shift the responsibility for project problems.

ARPA and the USARNG sponsored the project. ARI acted as the intermediary between ARPA (seen as the 'ultimate' customer in this relationship) and the contractor team. Since the contractor was working for ARI, ARI was the 'immediate' customer[6]. ARPA and the IANG provided the project SMEs. These personnel had a direct line of communication with the ultimate customer. They often gathered information from that customer about project goals that appeared to be inconsistent with that given by ARPA to ARI, or passed from ARI to the contractor. Two brief examples will illustrate these problems.

1) ARPA sent a separate contractor to Camp Dodge to gather information from the project about one of the planned 'collective' lanes. This contractor was to develop an alternative training module for this lane making heavy use of audio. This was consistent with ARPA's mission to try highly innovative technologies. The project SMEs interpreted this to mean that they had been relieved of the responsibility of preparing this lane. However, when the contractor asked ARI to ask ARPA if this was the case, ARPA said that they still expected this lane to be developed as originally proposed.

2) When there were unforseen delays in receiving materials from the BSTS project, the SMEs asked the ARPA sponsor for permission to concentrate efforts on the lanes training. This request was made on two occasions, and seemed to be agreed to. Consequently, there were delays in starting on the FSB staff training portions that could have been done in the absence of the BSTS materials. Later the contractor was criticized for being so far behind in the development of the staff training.

Part of the problem was due to the multiple channels of communication, rather than having one 'official' chain of command. Another part of the problem was that most of the direction was oral, very little was committed to paper. This made it more likely to be subject to multiple interpretations as it passed from person to person.

Another aspect of oversight is related to providing timely feedback to the project on the materials it is developing. Obviously, with the ARPA and IANG SMEs involved intimately in the project, they could vouch for the degree to which the project was on course and the materials

---

[6] This relationship was even more difficult because most of the work was performed by a subcontractor, whose 'immediate' client was the prime contractor.

being developed were acceptable. On the other hand, this might also have been a conflict of interest. When personnel from ARPA headquarters or ARI visited the project, they did not comment on the intermediate products. They were mostly concerned with whether the project was adhering to the original time lines, not the quality of the work being done.

Many visitors, from a number of military organizations, during visits to Camp Dodge for other purposes, made informal visits to the project staff buildings to look at the lane lessons. This included officers representing 2d Armor Division, III Corps, and Second Army, among others. Immediate, verbal feedback provided by those visitors -- favorable without exception -- was as informal as the visits, and the Camp Dodge contractor staff never received a copy of any written report evaluating the intermediate or final products. The project staff was, in effect, operating in a vacuum, without the help that feedback from external sources and organizations can provide.

Eventually, resolving the issues and misunderstandings required several telephonic and video conference calls, and the preparation of written documents describing responsibilities more clearly. Some of this might have been avoided by distributing clearer information about project goals in written form through all parallel chains of command.

<u>Recommendations</u>. Having both contractor and customer personnel working together requires special care in managing contract oversight. Directions given to one group must be made clear (written form preferred) and passed through the proper chain of command to the other. IPRs should focus on the status of the development as laid out in the plan for development and the quality of the materials being developed. The necessary trade-off between quality and timeliness, within a given budget, must be addressed directly.

REFERENCES

Deterline, W. A. (1994) *Formative Evaluation of Computer-Based Instructional Modules for the Forward Support Battalion*. Monterey, CA: U.S. Army Research Institute.

Golas, K. C. (1993) *Estimating Time to Develop Interactive Courseware in the 1990s*. Paper read at the 15th Interservice/Industry Training Systems and Education Conference.

Keesling, J. W. (1995) *Lanes Training Validation Report*. Monterey, CA: U.S. Army Research Institute.

APPENDIX A

Original Specification for FSB Company Training Lanes

APPENDIX B

Introduction to Multimedia Computer Based Instruction

This appendix describes three aspects of multimedia computer based instruction (CBI):

1) interactive instruction,
2) the use of multimedia components, and
3) the lesson/trainee interface -- navigating through the course.

Interactive Instruction

Interaction is the fundamental principle underlying CBI: The more the students interact with the material, the more they will learn. Students interact with the material by making active responses to questions and problems, and by receiving feedback on those responses. The active responses require the student to process the information, interpret it, and apply it. Feedback tells the students whether the response is correct or incorrect, supplying additional information about the error, or indicating the correct response.

The instructional developer's task is to design the presentation of the material and the student interactions and feedback, called guided practice. In some applications, the feedback may lead to an alternate instructional branch, if it has been demonstrated that a particular error is symptomatic of a problem requiring another instructional approach[7].

There are a variety of formats for eliciting active responses:

Select an answer from a list (multiple choice or true false)
Match terms or visuals from two lists
Arrange steps in the proper order
Enter short answers via the keyboard
Select items from a set, identifying correct procedures
Evaluate a description as correct or incorrect

In multimedia CBI the content of these formats may be text, audio, still drawing or photo, animation or video. For example, students may be asked to place text or pictorial representations of a sequence of steps in the proper order. Or, students may evaluate text or video

---

[7] The current project did not attempt to do the extensive testing that such elaborate feedback would require. The evaluation results indicate that most students understood the material quite well.

representations of a procedure as being correct or incorrect. Matching problems can be constructed of parallel text lists, or visuals, or combinations.

Feedback can be the simple statement that the answer was, or was not, correct. Or, it may state why. Again, the multiple media may be used to show, as well as state, the correct response.

Multimedia Components

The multimedia capabilities of contemporary desktop computers allow instruction to be enhanced with elements that increase realism (show rather than tell) and provide a richer learning environment. Using combinations of media may facilitate learning by engaging more of the student's brain in processing the information, and may be especially helpful to students with learning modality preferences other than printed text.

Briefly, some of the multimedia components and their uses are:

<u>Text</u>. Text is still one of the most efficient ways to present material of a didactic nature: rules, procedural steps, numerical tables, etc. Multimedia CBI can enhance text (hypertext) to allow students to navigate in a more *ad hoc*, less linear, fashion when they wish. Multimedia CBI can also assist students to learn how to deal with standard text references they must use (in the current project, the field manual, or FM, is a good example).

<u>Audio</u>. The combination of voice with music or sound effects is in general use as a form of introduction. Such uses are primarily cosmetic or attention-getting applications. In multimedia CBI, audio can be used to present information, direct attention to something on or off the screen, and guide actions at the computer, or nearby.

As a means of presenting information it is instructive to note that the spoken word is typically the basis of most television news programs. The graphics supplement the verbal description, but rarely displace it.

One use of audio that should be avoided is to use a voice to repeat, word for word, the text information that appears on the screen. Judicious use of audio makes it effective in providing emphasis on critical content and key points, and increasing the trainee's concentration on the information provided. This effect probably diminishes if audio is used too frequently, or for less critical content.

One aspect of audio one that is not characteristic of visual information that should be capitalized upon wherever possible is the non-directional nature of sound reception. In order to receive visual or text information from the computer, the trainee has to be looking at the screen, but audio information is received by the human ear no matter where the trainee is looking or what he or she is doing. The audio channel, for example, could guide a trainee through the tasks

of filling out a form, reading a map, finding something in a reference, or performing a variety of tasks, at or away from the computer.

Drawings and Photos. Drawings and photos may provide all of the graphic information that is needed to reinforce the learning from the text and audio modalities. Judicious choices must be made between still drawings, still photographs, animations and video. In general, any form of motion costs more in time and labor to produce, and requires more storage capacity than stills.

Videos may be a useful source of still images, however. It is often relatively economical to extract a still from a video, rather than prepare a separate graphic.

Photos are generally more realistic than drawings. But photographs are susceptible to problems with contrast, shadows and reflectance that may make a photo image ineffective for training. Professional photographers know how to avoid these problems, but may be too expensive for a particular project. Drawings can be competitive in cost compared to professional photos.

There are resources for photos and drawings. In the current setting, there were many line drawings that could be extracted from Army manuals. Even clip art collections could be used by coloring the black and white images, adding backgrounds, and in some cases, elements such as uniforms and weapons that 'militarized' the image. No more than 20 percent of the still images for this project were developed from scratch.

Animation and Video. One of the primary values of video is to show realistic movements and actions that the trainees are to learn, where timing and motions are critical. Several of the medical lessons made effective use of video for this purpose, showing how certain medical and treatment procedures are carried out. To a lesser degree, the maintenance lessons benefited from video for similar purposes.

Another use of animation or video, like audio, is for more cosmetic (as opposed to instructional) purposes: to introduce a topic or attract attention.

Animation is typically easier and more economical to provide than video. It focuses attention on the most essential elements. As the degree of realism required to make the instruction effective grows, the costs of animation (e.g. fully articulated human motion on a realistic background) may prove to be as expensive as shooting video. For example, to introduce a lesson concerning properly grounding a fuel tank-trailer, an animation was created to show the tank-trailer delivered by a tractor. Video taping the same scene would have been very costly.

The Lesson/Trainee Interface: Navigating through the Course

Although each lesson varies somewhat in its design and appearance, the basic components and functions are the same. When a trainee enters a lesson, the first screen offers the initial set of options, consisting of information about the lesson or about each of the topics in the lesson. Each of the options provides only information: this menu does not lead directly into the interactive lessons themselves. The trainee uses a mouse (or similar pointing device) to 'click' on the selection he or she desires.

At the bottom of every screen (except for special purpose screens, such as questions, matching items, etc.) five clickable 'buttons' are provided for navigational purposes:

Figure 1. Navigation button template.

The most frequently used button is the Next button, which displays the next screen in the sequence. The Previous button moves back in the sequence, sometimes to the immediate previous screen, but sometimes, due to the IconAuthor structuring, to the screen at the beginning of the topic sequence. The Quit button does exactly that, quitting the sequence and exiting the lesson. The Menu button presents the menu screen shown in Figure 2. The Options button presents a menu of options, the principle one of which is a glossary of technical and military terms, abbreviations, and acronyms.

After selecting information options from the opening screen, the trainee clicks on either the Next button or the Menu button, which presents the screen shown in Figure 2.

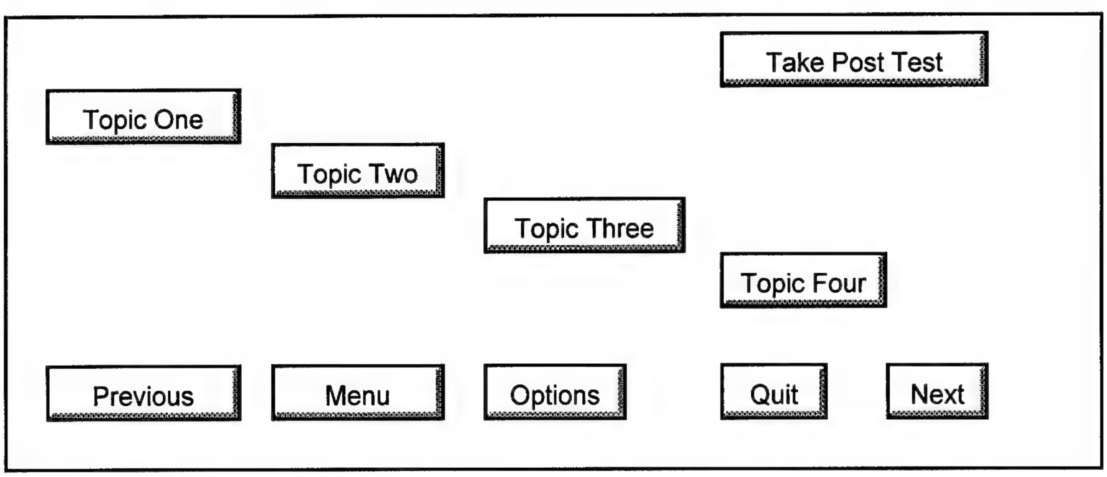

Figure 2. Lesson Selection Menu

The *Take Post Test* button in the upper right corner of the screen allows trainees to move directly to the post test if they feel they have already mastered all of the required competencies.

Before the trainee can select a topic, a small window appears asking the trainee whether he or she wants to take the lesson "for record," or simply to review the material in a "browse" mode. The trainee clicks on either choice, then clicks on the desired topic. Each of the topic buttons moves directly into the instructional sequence for that topic. The trainee moves through a topic, answering questions or carrying out tasks, and eventually taking a quiz at the end of the topic.

The "browse" mode was included in the lessons at the request of ARPA. There is no difference between the browse and “for record” modes in terms of what the trainee sees and does during the lesson. The difference is that the management system does not keep records on the performance of browsers. Trainees or others who want to look over the lessons to see what they contain can easily do so; soldiers who want to obtain specific items of information that might be more difficult to find in their manuals can use the browse mode for that purpose. The browse mode can also be used for review and refresher use, although for those sometimes essential purposes, the lessons might more appropriately be taken for the record.

Summary

The combination of interactive instruction with multimedia components in an instructional environment that permits unlimited browsing and review should engage the students effectively and allow them to progress to skill mastery. The formative evaluation of the lessons prepared for this project illustrates the effectiveness of this technology.

APPENDIX C

Original Specification for FSB Staff Lessons

APPENDIX D

STAFF TRAINING VALIDATION

INTRODUCTION

Background

The Advanced Research Projects Agency (ARPA) and the Army National Guard (ARNG) contracted with BDM Federal, Inc. to develop a series of computer-based courses to instruct Forward Support Battalion (FSB) and Support Battalion (SB) staff officers. These courses were to be based upon similar courses developed for the battle staffs of Armor and Mechanized Infantry battalions in a parallel effort sponsored by ARPA and the ARNG.

The staff of the FSB is organized somewhat differently from that of a combat battalion. One person serves in the combined roles of S2 and S3 and there is an additional officer, the Support Operations Officer (SPO). A Support Battalion for a separate brigade has all of the staff positions of a combat battalion, plus a Battalion Materials Management Officer (BMMO). The courses from the Battle Staff Training System (BSTS) had to be modified to adapt them to the duties of the corresponding staff position in the FSB or SB. The courses for the SPO and the BMMO were developed by the ARPA, ARNG and contractor staff at Camp Dodge, Iowa.

The BSTS project commenced at the same time as the project to develop training for the FSB and SB. The courses received from the BSTS became available late in the development cycle for the FSB project. To meet project deadlines, BSTS courses that had not been validated were used as the basis for making modifications to suit the FSB and SB staffs. The validation information presented here concerns only the versions of the courses as adapted to the FSB and SB staffs.

There are two types of lessons in the staff courses: 1) Fully CBI lessons, in which the instruction is done via interaction with the computer, and 2) text lessons, in which the instruction is done by having the student read Army doctrinal materials. There is a computer managed component of both lessons, consisting of a pretest, posttest and a practical exercise for each lesson. This component allows student progress to be entered into the training management system, and gives the student an opportunity to exercise the skills he has attained through the instruction.

The formative evaluation of the staff lessons was somewhat different from that described for the FSB Lanes Training development (Keesling, 1995). The design of the courses was essentially 'given' in the materials developed by the BSTS project. However, as ARPA staff at Camp Dodge adapted the lessons to the FSB/SB some were greatly changed, while others were

only slightly modified. In some cases the lessons were recombined to suit the FSB/SB instructional needs.

For the SPO and BMMO courses the formative evaluation began in the design phase. Subject-matter experts and instructional designers examined the content and sequencing to determine if they were appropriate on a-priori grounds. The decision was made to develop a lesson as fully CBI or text. The CBI lessons went through a phase of 'Alpha testing' in which the developers performed a trial-run of the lesson to determine if the courseware tracked with the storyboards, and to identify flaws in the logic of presentation and errors or ambiguities in the instructions for navigation through the course.

All of the lessons for all staff positions went through a phase of 'Beta testing' in which subjects took the lessons in their near-final form to determine if they could navigate through the course successfully and the extent to which they learned from the material. Errors detected in the content or in the navigation directions were corrected in the final version of the lesson.

Purpose

This report documents the validation testing performed on the staff lessons developed for the FSB and SB. The report documents the performance gains attained by the test subjects and the typical amounts of time required to complete the lessons.

ANALYSIS OF BETA TEST DATA

Data

Exhibit D-1 lists the data available for this validation study. There were 12 fully CBI lessons and 27 text lessons. It was difficult to find a large pool of subjects to test these lessons. The ARPA staff conducted the testing among themselves to facilitate project completion. Thirty-one of the lessons had only one beta test, two lessons had two beta tests and one had four beta tests. In total, 48 beta test records were obtained[8].

Analysis

The results will be presented in two sections, one for the fully CBI lessons and one for the text lessons. Each section will discuss the percentage of students who attained mastery

---

[8] Since the first lesson for the SPO was identical to the first lesson for the BMMO, the two records for the SPO were averaged and a synthetic record with these averages was inserted for BMMO lesson one.

(defined as 80 percent or better correct on the posttest), the average pretest and posttest scores, and the amount of time required to take the lesson.

CBI Lessons. There were 15 beta tests performed on the 12 CBI lessons[9]. Four of these students obtained pretest scores of 80 percent or higher. Of the other 11 records, 10 (or 91 percent) attained mastery level on the posttest. Table 1 shows the average pretest and posttest attainment of these students. These scores confirm that the subjects who were non-masters at the time of the pretest learned a considerable amount of information from these lessons. Even the subjects who were masters at the pretest improved their scores substantially.

Table 1.
Pretest and Posttest average scores for fully CBI lessons.

	Pretest Non-Masters N = 11	Pretest Masters N = 4
Average Pretest Score	64.1 (9.2)	83.7 (3.3)
Average Posttest Score	84.4 (6.3)	93.5 (8.5)

Numbers in parentheses are standard deviations.

On average, it took 58 minutes to complete each of these fully CBI lessons, including the pretest and posttests. The lessons themselves took about 32 minutes, on average. These times should allow National Guard staff officers to take these lessons during weekend drill periods.

Text Lessons. There were 32 beta test records on the 27 text lessons[10]. These records were obtained from subjects who took the pretest, performed the practical exercise, and took the posttest. They did not follow the instructions to read the Army doctrinal materials. The purpose of these beta tests was to examine the functionality of the courseware managing the instruction and testing.

Although it may seem irrelevant to examine the scores obtained by these subjects, they are relevant to the use of these lessons as refresher materials. The subjects who performed the beta testing were generally knowledgeable in the area of staff functions. One was a Lieutenant Colonel, one a Major and one a Captain, all of whom had served on battalion staffs in the

[9] One additional beta test record did not have a pretest score and was not counted in the following analyses. The student attained mastery on the posttest (87 percent correct).

[10] There was one additional record that did not have a pretest recorded and was not included in these analyses. The subject performing this beta test obtained a score of 80 percent correct on the posttest.

ARNG. These subjects generated 12 records indicating that they were masters at the time of the pretest. Of the 20 other records, 12 (or 60 percent) indicated attainment of mastery by the time of the posttest. Recall that the text lessons contained a practical exercise as well as the pretest that could contribute to the student's orientation to and understanding of the material. Further examination of the records showed that three of the records indicated that the beta test subject did not take the practical exercise. In all three of these instances the subject did not attain mastery on the posttest. When these records are set aside, 12 out of 17 (or 70 percent) of the pretest nonmasters attained mastery by the time of the posttest. This evidence supports the use of these lessons as refreshers for knowledgeable staff members.

Table 2 shows the average pretest and posttest scores for the beta test records for the text lessons. These averages confirm that the lessons could be used as refresher materials. In order to validate the entire lesson, subjects that have little staff experience would have to be instructed to take the entire lesson, including reading the textual materials.

Table 2.

Pretest and Posttest average scores for text lessons.

	Pretest Non-Masters		
	Did Not Take Practical Exercise N = 3	Took Practical Exercise N = 17	Pretest Masters N = 12
Average Pretest Score	61.7 (6.8)	66.0 (8.7)	84.3 (6.2)
Average Posttest Score	73.7 (1.2)	80.2 (8.1)	95.3 (4.9)

Numbers in parentheses are standard deviations.

It took the subjects who were not masters at pretest about 36 minutes to complete the pretest, practical exercise, and posttest. This brief period of time should be relatively easy to incorporate into a training weekend for ARNG officers. It is not possible to predict the amount of time required to read the textual materials. The CBI system allows the officer to read these on his own and return to finish the lesson at a later time. This should facilitate use of the complete text lessons by new staff officers.

CONCLUSION

The CBI lessons developed for the FSB and SB staff officers offer an opportunity to learn important concepts in a reasonably brief span of time. The text lessons function appropriately and may be used without the text material as a refresher for officers with some experience. It is assumed that since the text material is from Army doctrinal sources it will be appropriate to train the less sophisticated officers to a state of subject mastery.

EXHIBIT D-1

Beta Test Records for FSB/SB Staff Lessons

POSITION	LESSON	PRETEST	POSTTEST	PRETIME	LSNTIME	POSTTIME
BMMO	BM1	70.0	90.0	13.0	36.0	13.0
BMMO	BM2	86.0	86.0	10.0	15.0	10.0
BMMO	BM2	71.0	86.0	10.0	10.0	10.0
BMMO	BM3	76.0	81.0	4.0	15.0	10.0
BMMO	BM3	76.0	81.0	10.0	10.0	10.0
BMMO	BM4	70.0	82.0	8.0	5.0	7.0
BMMO	BM5	72.0	80.0	10.0	15.0	10.0
BMMO	BM5	64.0	72.0	10.0	10.0	10.0
BMMO	BM6	80.0	100.0	7.0	12.0	6.0
CORE	CC1	50.0	80.0	15.0	15.0	15.0
CORE	CC2	72.0	83.0	15.0	30.0	10.0
CORE	CC3	67.0	85.0	15.0	30.0	15.0
S1	S11	70.0	80.0	3.0	16.0	2.0
S1	S12	61.0	94.0	7.0	19.0	3.0
S1	S13	60.0	60.0	4.0	5.0	3.0
S1	S14	63.0	70.0	10.0	14.0	5.0
S1	S15	80.0	90.0	5.0	4.0	3.0
S1	S16	80.0	93.0	4.0	6.0	2.0
S2	S21	86.0	92.0	20.0	30.0	20.0
S2	S22	90.0	95.0	10.0	20.0	10.0
S2	S23	72.0	85.0	12.0	20.0	10.0
S2	S24	50.0	88.0	7.0	20.0	10.0
S2	S25	82.0	82.0	10.0	25.0	12.0
S2	S26	78.0	89.0	12.0	25.0	10.0
S2	S27	80.0	90.0	10.0	25.0	10.0
S3	S31	80.0	100.0	18.0	25.0	10.0
S3	S32	80.0	100.0	15.0	20.0	15.0
S3	S33	100.0	100.0	9.0	6.0	11.0
S4	S41	70.0	82.0	10.0	35.0	35.0
S4	S42	.	87.0	.	10.0	20.0
SPO	SP1	75.0	80.0	16.0	27.0	15.0
SPO	SP1	65.0	100.0	10.0	45.0	10.0
SPO	SP2	70.0	84.0	5.0	35.0	4.0
SPO	SP2	.	80.0	.	10.0	10.0
SPO	SP3	67.0	80.0	10.0	35.0	15.0
SPO	SP3	67.0	75.0	15.0	15.0	15.0
SPO	SP4	62.0	78.0	20.0	20.0	20.0
SPO	SP4	54.0	73.0	15.0	15.0	15.0
SPO	SP5	54.0	77.0	5.0	16.0	4.0
SPO	SP6	80.0	100.0	7.0	43.0	13.0
SPO	SP6	87.0	100.0	15.0	40.0	10.0
SPO	SP6	56.0	81.0	14.0	35.0	16.0
SPO	SP6	69.0	88.0	17.0	41.0	14.0
SPO	SP7	64.0	73.0	10.0	10.0	10.0
XO	XO1	83.0	96.0	8.0	30.0	3.0
XO	XO2	52.0	83.0	7.0	49.0	3.0
XO	XO3	83.0	94.0	6.0	14.0	4.0
XO	XO4	90.0	100.0	2.0	9.0	2.0
XO	GXO5	46.0	73.0	7.0	33.0	5.0